Under the Big Sky

Northeast Montana Weather Spotter Newsletter

Summer Edition 2005

This edition includes:

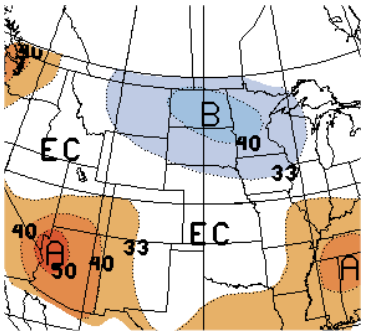
- 2005 Summer Weather Outlook
- Lewis and Clark: Corps of Discovery Northeast Montana Weather
- Spring 2005 Cooperative Weather Observer Awards
- 2004 and 2005 Amazing Weather Spotters
- Build Your Own Tornado
- Lightning Safety (National Lightning Safety Awareness Week is Jun 19-25!)
- Interpreting the Radar Images
- Ask the Meteorologist: How Does Lightning Form?
- Ask the Meteorologist: What is a Blue Moon?

Printable Version

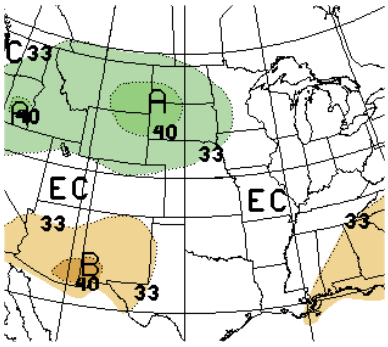
The Summer and Autumn Weather Outlook for Northeast Montana and El Nino Explained

By Corey Bogel, General Forecaster

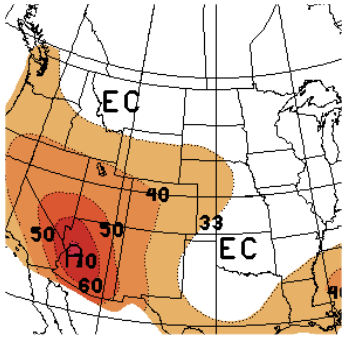
The latest official climate outlook (issued May 19, 2005) from the Climate Prediction Center (CPC) is for below average temperatures with above average precipitation this summer. There is an equal chance of either above or below average temperatures and precipitation this fall. It is still a long way out, but there is some signal that temperatures may be above average this winter, with below average precipitation should a weak El Nino re-develop.



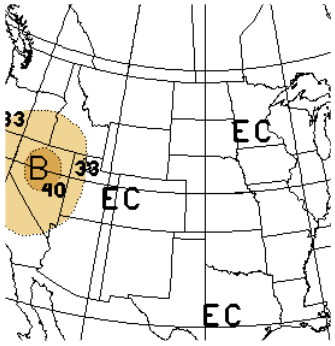
June-July-Aug **Temperature** Outlook



June-July-Aug **Precipitation** Outlook



Aug-Sept-Oct **Temperature** Outlook



Aug-Sept-Oct **Precipitation** Outlook

EC refers to equal chances of above or below normal conditions.

So, what is El Nino? The term El Nino refers to the large-scale ocean-atmosphere climate phenomenon linked to a periodic warming in sea-surface temperatures across the central and east-central equatorial Pacific (between approximately the date line and 120W). La Nina is the opposite of an El Nino and refers to the periodic cooling of ocean surface temperatures in the central and east-central equatorial Pacific that occurs every 3 to 5 years or so.

Why does an El Nino/La Nina form? El Nino and La Nina are naturally occurring phenomena that result from interactions between the ocean surface and the atmosphere over the tropical Pacific. Changes in the ocean surface temperatures affect tropical rainfall patterns and atmospheric winds over the Pacific Ocean, which in turn impact the ocean temperatures and currents. The El Nino and La Nina related patterns of tropical rainfall cause changes in the weather patterns around the globe.

During the summer of 2004 a weak El Nino developed. The El Nino came to an end as of the spring of 2005. The most recent El Nino was weak, but was, at least in part, responsible for the warmer and drier winter across Northeast Montana.

The current forecast is for ENSO-neutral conditions this summer into the fall. ENSO-neutral refers to those periods when neither El Nino nor La Nina is present. These periods often coincide with the transition between El Nino and La Nina events.

There is the possibility of a warming to a borderline weak El Nino again by this winter, but it is still highly uncertain as to whether the El Nino will re-develop. Should a weak El Nino form, it would be the same conditions which, in part, may have led to a warm winter last year across northeast Montana.

You might be wondering how long El Nino and La Nina typically last? El Nino typically lasts 9-12 months, and La Nina typically lasts 1-3 years. They both tend to develop during March-June, reach peak intensity during December-April, and then weaken during May-July. However, prolonged El Niño episodes have lasted 2 years and even as long as 3-4 years.

El Nino and La Nina are typically strongest during December-April because the equatorial Pacific sea-surface temperatures are normally warmest at this time of the year. Consequently, a slight warming of the waters due to El Nino can result in a major redistribution of tropical convective rainfall, whereas a slight cooling due to La Nina can restrict the tropical convection to Indonesia. This redistribution of tropical convective rainfall affects the jet stream - which is the current of wind at about 20,000 feet above the Earth's surface. There tends, during El Nino event, to be an enhanced flow of marine air into the western United States, along with a reduced northerly flow of cold air from Canada into the western U.S. These conditions result in a milder than normal winter across the northern state and western Canada. The correlation to winter precipitation (mostly snowfall in northeast Montana) is not as strong. There is a strong correlation that above normal precipitation falls during El Nino events in California, along the Gulf Coast, and southeast U.S. due to an active southern branch of the jet stream.

How do scientists detect El Nino and La Nina and predict their evolution? Scientists from NOAA (National Oceanic and Atmospheric Administration) and other agencies use a variety of tools and techniques to monitor and forecast changes in the Pacific Ocean and the impact of those changes on global weather patterns. In the tropical Pacific Ocean, El Niño is detected by many methods, including satellites, a network of 70 buoys, sea level analysis, and expendable buoys.

If you have any questions concerning El Nino or La Nina and their impact on the weather in northeast Montana, please contact either Donald Simonsen, the climate focal point, or Corey Bogel, the assistant climate focal point.

To see the latest climate outlooks which are issued in the third week of each month, you can go to: http://www.cpc.noaa.gov/products/predictions/30day/

Lewis and Clark: Corps of Discovery
Northeast Montana Weather 200 years ago
By Tanja Fransen, Warning Coordination Meteorologist

Things haven't changed all that much weather wise since Lewis and Clark's Corp of Discovery traveled through northeastern Montana 199 years ago. They encountered the same unrelenting spring winds we face every day, and many times in their journal they noted that it rained, but that "it was but a mere sprinkle."

When they first headed into present day Montana, it was the 27th of April 1805. The Corp of Discovery took twice daily weather observations, including temperature, wind direction, cloud conditions, and an observation about whether the river had fallen or risen while they were at the camp site. They took the observations each morning at sunrise, and then again at 4 p.m. in the afternoon. Many of the men who kept journals also commented on the weather itself, especially if it was particularly an awful weather day.

The biggest obstacle in our region was the wind. Oftentimes they had to stop until the winds died down, or else risk the canoes being swamped by the waves that were created. (Just think about a day of strong winds on Fort Peck Lake with a 20 foot Bayliner, and you'll have the idea of what they went through).

On May 14th, the near constant winds came to a head one afternoon upstream of today's Fort Peck Dam. Interpreter Charbonneau was at the helm of a perogue (and untrained for the position) when Sergeant Ordway expoundes, "*About 4 oClock the white peroque of the Captains was Sailing a long, there came a violent gust of wind from the NW which was to the contrary to the course they were sailing. It took the sail and before they had time to douse it turned the perogue down on one Side So that she filled with water, and would have turned over had it not been for the awning which prevented it. With much a diew they got the sail in and got the pirogue to shore*." With direct orders from quick thinking Peter Cruzatte, they righted the perogue. In the midst of the tipping craft was Sacagawea and her son Jean Baptiste known as "Little Pomp." She calmly leaned out and gathered instruments, books and medicine critical to the Expedition, and even more critically she saved the journals that would later become the historical pieces that allow us to know what the Corp of Discovery encountered.

The Discovery Expedition of St. Charles Reenactment Group visited the top of Tower Hill and the Milk River Overlook Site on May 8, 2005, exactly 200 years after the original Corps of Discovery named the Milk River. Photos by Mike Fransen.

Cooperative Weather Observers Receive Awards

Several awards were given out this spring to some of the dedicated cooperative weather observers that serve northeast Montana. These folks are just one of nearly 11,000 volunteer stations nation wide that collects daily weather information including maximum and minimum temperatures along with daily precipitation amounts from rain and snow.

Volunteer weather observers conscientiously contribute their time so that observations can provide the vital information needed. These data are invaluable in learning more about the floods, droughts, heat and cold waves affecting us all. The data are also used in agricultural planning and assessment, engineering, environmental-impact assessment, utilities planning, and litigation. COOP data plays a critical role in efforts to recognize and evaluate the extent of human impacts on climate from local to global scales.

Observers frequently record temperature and precipitation daily and send those reports monthly to the National Climatic Data Center (NCDC) or an NWS office. Many cooperative observers provide additional hydrological or meteorological data, such as evaporation. Data is transmitted via telephone, computer or mail. Equipment used at NWS cooperative stations may be owned by the NWS, the observer, or by a company or other government agency, as long as it meets NWS equipment standards.

The first network of cooperative stations was set up as a result of an act of Congress in 1890 that established the Weather Bureau, but many COOP stations began operation long before that time. John Campanius Holm's weather records, taken without the benefit of instruments in 1644-45, were the earliest known observations in the United States. Subsequently many persons, including George Washington, Thomas Jefferson, and Benjamin Franklin, maintained weather records. Thomas Jefferson maintained an almost unbroken record of weather observations between 1776 and 1816, and George Washington took his last observation just a few days before he died.

Eric Albus, COOP observer for the river gage at Bjornberg Bridge on the Milk River near Saco Montana, received a 15 Year Length of Service Award

Charles and Darlene Moline located 3 miles southwest of Brockway, MT received a 20 Year Length of Service Award.

Geraldine Pennell, COOP observer at Culbertson , MT river gauge, received a 20 Year Length of Service Award.

Jerald and Bonnie Bergman were presented with a 25 Year Length of Service Award.

Eugene Meyer located in Westby, MT received a 15 Year Length of Service Award.

Darcel Wesen and Ben Martin with the Montana Aviation Research Company, located at St. Marie, MT received a 10 Year Length of Service Award.

Spotters...Incredible Help to the National Weather Service!

By Tanja Fransen, Warning Coordination Meteorologist

The NWS in Glasgow is extremely fortunate to have about 1100 weather spotters in the 12 counties it provides forecast services for. These folks have come to the severe weather (Skywarn) two hour course at least once, and many of the spotters attend the courses every year. This makes my job not only a lot of fun (visiting with you all), but also a bit difficult because I don't want to show the same stuff that was shown last year, and so I am constantly trying to update the presentation with new material so as to continue the excellent interest we have.

In 2004, NWS Glasgow honored two weather spotters for their excellent help with our spotter program. **Gene Ronningen**, from Savage, was recognized for his excellent damage survey and assessment after a storm on July 11, 2004 hit the Savage area. Gene took photographs, drew up a diagram showing the buildings in the photos and the direction of the debris, and typed up an excellent assessment report. The event had widespread damage across northeastern Montana, and his help allowed the staff at the NWS to focus on many of the other areas that were damaged as well.

Terry Willard from Plentywood was recognized for his excellent spotter report of a rotating wall cloud which helped the meteorologists on duty decide to upgrade a severe thunderstorm warning to a tornado warning. There were a total of 3 tornados the evening of July 14th, 2004. Terry reported to the office several times prior to and during the tornados which provided excellent information that went right back into the warnings and statements issued by NWS Glasgow.

Terry Willard receives his certificate of appreciation from Tanja Fransen, NWS Glasgow Warning Coordination Meteorologist.

This year we have two spotters who have gone above and beyond a normal report of severe weather to the NWS office. **Eldon Moos**, from the Farmer's Elevator in Circle has been out and about taking photographs of the storms that hit the area on June 6th. During the event he sent photos of what the storms looked like and the meteorologists issuing the warnings were able to see exactly what was occurring. He also sent many, many photos (some real time) of the flooding on Horsecreek near Circle and the damage to the 8 large grain bins in Lindsay.

Gary Kreiman, from 10 miles north of Lindsay is such a weather enthusiast, that he has an automated weather station at his home. The same June 6th storm blew through his area, and he called immediately to let us know about an 80 mph wind gust. He later called to update it to 86 mph, and also report the rainfall total. Gary also called back the next day to provide damage information from the area, and make sure that the staff at NWS Glasgow had all the information they needed.

All of the County DES Coordinators are also weather spotters, and many have been attending the spotter courses for years. Three DES coordinators who have been utilized several times already this year include **Mistica Hisdahl** from McCone County, **Rick Seiler** from Valley County and **John Pisk** from Prairie County. They have spent an incredible amount of time following up after severe weather and documenting the damage in photographs and reports that have been shared with us and the State Disaster and Emergency Services Office. Rick even comes into the NWS office during severe weather to help us contact people and get information on what is occurring. We would love to tell these dedicated people that things will slow down, but we still have a lot of summer left.

As more events unfold and we continue to get the many reports from our amazing spotters, we will add updates to this newsletter.

SAFELY VIEW A TORNADO IN MONTANA… BY MAKING ONE

Mark Pellerito – Meteorologist Intern

At your Northeast Montana get-togethers, you explain to your friends and family how you are a spotter for the National Weather Service. Many of them ooh and ahh as you tell them your weather war stories, like how you were pelted by the golf ball size hail stones that you reported last summer. You even show them some pictures from Skywarn training, or that photo you took of a shelf cloud from when you were driving back from Billings that one time. You show them a couple weather instruments you have in your possession. But there is always that one niece or nephew that simply is not satisfied. They yawn unappreciatively, with eyes darting around for a more exciting venue to satiate their short attention span. How do you compete in this day and age, with computers, DVD's, and video games? With cardboard, duct tape, and plastic wrap.

Here is how to make your own tornado-in-a-box. You'll want to obtain four pieces of cardboard (or four sides of a big cardboard box), roughly of 14-by-28 inch dimensions. For all four pieces, cut a one inch-wide slit about one inch from the right edge. For two of the pieces, cut a sizable square which will be used as a viewing window. Make sure the square is large enough for adequate viewing, yet small enough to maintain the structural integrity of the cardboard. You should end up with something like this:

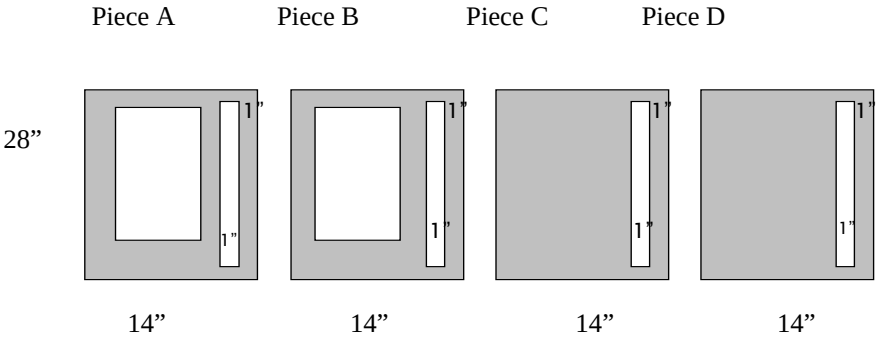


FIGURE 1: FOUR SIDES NEEDED FOR TORNADO-IN-A-BOX

Next, use plastic wrap to cover up the viewing windows. You'll want to affix the plastic, using tape or other means, to prevent air from flowing through the window. Optionally, you may want to also use paint or marker to color the other side of each cardboard piece black – so when the pieces form the box, the inside of it is dark for optimal viewing of the tornado.

Then, using duct tape, connect the four pieces in order (A-B-C-D) to make a four-sided box with the viewing windows on two consecutive sides. The one-inch slits should all be towards the right edge of each side of the box. Looking at the assembled box from the top, the openings should look like Figure 2 (below).

Now, all you need is boiling water. Get a shallow pan of water on a hot plate, or other small boiler of some sort. Place the assembled box over - and around - the soon-to-be-boiling pan of water. Hot air inside the box will begin to rise. As this happens, air from the outside begins to draw in through the one-inch slits to replace the rising air. This produces a circulation, which if viewed from the top, looks like figure 3. Once the water boils, the circulation becomes visible in the form of a "steam tornado." You can make it more dramatic and visible by turning off all lights, then shining a flashlight (or desk lamp, etc.) into the box at an angle from the top.

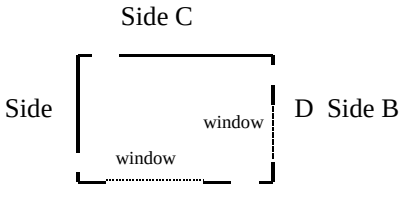


FIGURE 2: ASSEMBLED BOX VIEWED FROM THE TOP

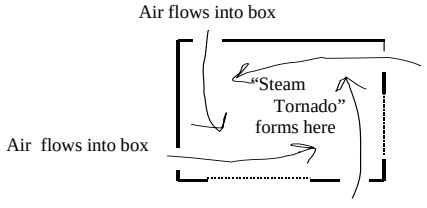


FIGURE 3: CIRCULATION VIEWED FROM THE TOP

I'm sure you'll enjoy your own tornado in a box! But one last thing: if you really want to knock their socks off, add dry ice to the water. Dry ice produces the best results, because the very fine vapor that is emitted when mixing water with dry ice. It is very effective for displaying swirling currents inside your box – and the little tornado itself.

Lightning:
A Potentially Deadly Strike With Each Flash

National Lightning Safety Awareness Week
June 19-25, 2005

Every year lightning kills approximately 70 people and injures another 300. In the last 10 years in Montana there have been 6 deaths and 14 injuries due to lightning. In the United States, there are an estimated 25 million cloud-to-ground lightning flashes each year, and a recent storm system over the Ark-La-Tex region produced 17,000 strikes within one hour! Lightning can be fascinating to watch, but it is also extremely dangerous. Because lightning usually claims only one or two victims at a time it generally receives much less attention than the more destructive weather-related killers.

There are two very easy things to remember when it comes to lightning safety:

1. If you see a storm coming your way, stop what you are doing and go inside, or into a vehicle if a building is not available.
2. When you hear thunder within 30 seconds of a lightning strike, you are close enough to be hit. The thunderstorm is within 6 miles of you. Once inside, wait until 30 minutes after the last clap of thunder before going outside again. This is known as the 30-30 Rule.

Outdoor Safety: Most lightning deaths and injuries in the United States occur during the summer months when the combination of lightning and outdoor summertime activities reaches a peak. During the summer, people take advantage of the warm weather to enjoy a multitude of outdoor recreational activities. Unfortunately, those outdoor recreational activities can put them at greater risk of being struck by lightning. People involved in activities such as farming, boating, swimming, fishing, bicycling, golfing, jogging, walking, hiking, camping, or working out of doors all need to take the appropriate actions in a timely manner when thunderstorms approach. *Where organized sports activities take place, coaches, umpires, referees, or camp counselors must protect the safety of the participants by stopping the activities sooner, so that the participants and spectators can get to a safe place before the lightning threat becomes significant.* To reduce the threat of death or injury, those in charge of organized outdoor activities should develop and follow a plan to keep participants and spectators safe from lightning.

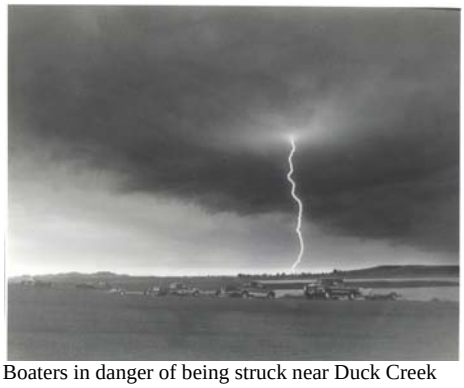
Photos by Gene Rhoden

Indoor Safety: There are three main ways lightning enters homes and buildings: (1) a direct strike, (2) through wires or pipes that extend outside the structure, and (3) through the ground. Regardless of the method of entrance, once in a structure, the lightning can travel through the electrical, phone, plumbing, and radio/television reception systems. Lightning can also travel through any metal wires or bars in concrete walls or flooring.

Phone use is the leading cause of indoor lightning injuries in the United States. Lightning can travel long distances in both phone and electrical wires, particularly in rural areas. Stay away from windows and doors as these can provide the path for a direct strike to enter a home. Do not lie on the concrete floor of a garage as it likely contains a wire mesh. In general, basements are a safe place to go during thunderstorms. However, there are some things to keep in mind. Avoid contact with concrete walls which may contain metal reinforcing bars. Avoid washers and dryers since they not only have contacts with the plumbing and electrical systems, but also contain an electrical path to the outside through the dryer vent.

Lightning also causes significant damage to personal property each year. In addition to direct strikes, lightning generates electrical surges that can damage electronic equipment some distance from the actual strike. Typical surge protectors will NOT protect equipment from a lightning strike. To the extent possible, unplug any appliances or electronic equipment from all conductors well before a thunderstorm threatens. This includes not only the electrical system, but also the reception system. If you plan to be away from your home when thunderstorms are possible, be sure to unplug unneeded equipment before you leave.

A tennis shoe from a person who was struck by lightning.



Boaters in danger of being struck near Duck Creek (From Good Evening Glasgow)

ODDS OF BECOMING A LIGHTNING VICTIM	
U.S. 2000 Census population	280,000,000
Odds of being struck by lightning in a given year (reported deaths + injuries)	1/700,000
Odds of being struck by lightning in a given year (estimated total deaths + injuries)	1/240,000
Odds of being struck in your lifetime (Est. 80 years)	1/3000
Odds you will be affected by someone being struck (Ten people affected for every one struck)	1/300

Remember that Lightning Kills…Play It Safe

www.weather.gov/glasgow
www.lightningsafety.noaa.gov

Radar Colors – What do they Mean?

-by Ted Jamba/Radar Focal Point

On the internet, our radar displays many different colors. This article is your guide on how to interpret them and know what is occurring throughout your area. The radar that covers northeast Montana is always in operation and has had very little down time due to failure. Over the past year, the radar has only failed for a total of 6.25 hours.

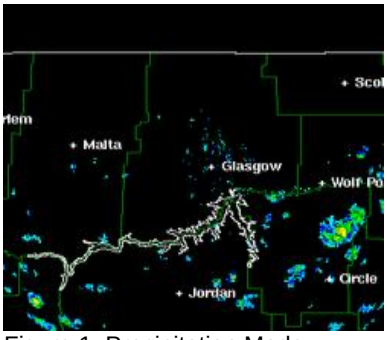


Figure 1. Precipitation Mode

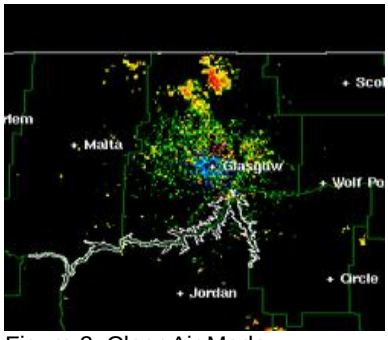


Figure 2. Clear Air Mode

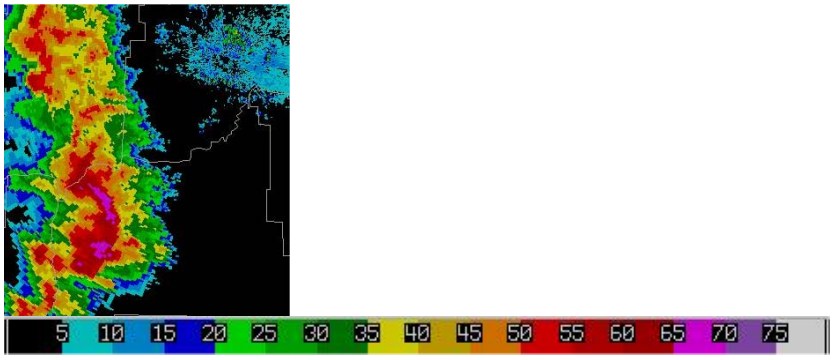
Figure 1 is a snapshot of the radar (from the internet) showing a rainshower on the right (between Circle and Wolf Point). The colors are different than what is seen in Figure 2, but the echo in Figure 1 is more intense. They are showing the base reflectivity, which refers to the lowest level of the storm that the radar is looking at. If it were a composite reflectivity image, it would be showing the most intense portion of the storm throughout all the levels that the radar beam is looking at.

The WSR-88D radar in Glasgow has two operational modes; one for precipitation and one for little or no precipitation. On the internet, when the radar echoes are yellow, red and occasionally white, the radar is running in "Clear-Air Mode." In Figure 1, the blues, greens and yellow indicate that the radar is operating in "Precipitation Mode." If you are lucky (and you're looping the images), you'll see the same echoes change colors when the radar switches from one mode to another.

There are several reasons for the radar to have these two modes of operation, one of them being to save on wear and tear of the system. The majority of the time the radar is run in "Clear-Air Mode" because we do not have precipitation occurring. It runs at a slower pace and scans just 5 elevation slices in the atmosphere. In this mode, many of the echoes in yellow and red represent clouds. Dark red and white echoes sometimes indicate light precipitation is occurring.

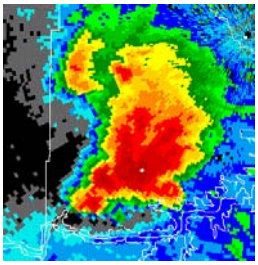
When heavy rain or snow, or thunderstorms are expected, the radar is put into "Precipitation Mode." Computer algorithms generate a suite of products when the radar is in this mode, to help forecasters issue severe weather warnings, mainly for severe thunderstorms and tornadoes. In this mode, the radar spins a bit faster and looks at many more elevation slices through the atmosphere. The radar is able to estimate things like the size of hail that falling from a thunderstorm, or give an approximation of wind speeds. Computer generated alerts are even sent to the forecasters to apprise them of

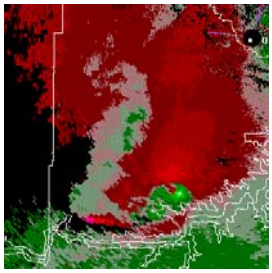
storms that are becoming strong. When you see really bright colors in this mode, it is an indication that the particles the radar beam is reflecting off of are fairly large. It could be large raindrops, big snowflakes or even hail.



The above photo shows a thunderstorm in western Garfield County with bright pink in the center. If you look at the scale with the photo, it shows the bright pink in the 65-70 range. Radar returns are measure in Dbz (Decibel of reflectivity)) so this storm has a 65-70 Dbz intensity. That is pretty strong for our area, and oftentimes when storms get that intense, the NWS will issue a warning for it.

The radar can also measure which way things are moving, and how fast they are moving. This is referred to as velocity data. The image below shows the base reflectivity and storm relative motion data of a thunderstorm in southern Valley County. We know the storm is fairly intense because of the dark red and white in the photo on the left. The photo on the right is showing us how things are moving within the storm. The radar at Glasgow is the little black circle in the upper right hand corner of the image. Where you see green, it means the particles in the atmosphere are moving towards the radar. The red is moving away from the radar. Just to the west of the Pines Recreation Area you can see the red and green intermixing. This is showing an area of rotation, which the forecasters at WFO Glasgow issued a tornado warning on. In the reflectivity image, there is an appendage that appears in the same area as the red and green swirl. We refer to this as a "hook echo." These are classic signs of a tornadic thunderstorm.





How Does Lightning and Thunder Form?

By Tom Salem, Science and Operations Officer

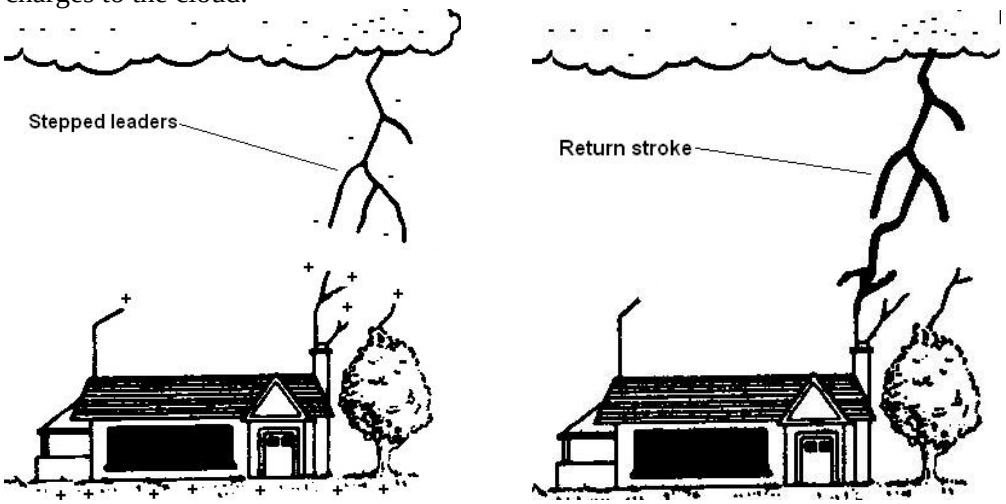
Even before Benjamin Franklin's famous kite flying experiment which proved lightning was electrical; scientists were looking at lightning and trying to figure out what was the cause. Questions still remain today about the causes of lightning. However over the last 250 years, scientists have learned a lot including answers to these questions: What causes lightning? How does lightning start? And what causes thunder? In this article, we will briefly discuss these questions.

What causes lightning?

Lightning is the way the atmosphere balances the charges that have been separated. The charges are separated by the collision of rain and ice particles. During the collision of the particles an electron (which has a negative charge) is stripped one of the particles. Thus having the lower part of a thunderstorm filled with negatively charged particles. While the earth surface now has more of a positive charge, the charge difference will continue to build as the atmosphere does not conduct electricity well at all.

How does lightning start?

Once there is enough charge build up between the cloud and the ground a stepped leader (with a negative charge) will start toward the ground. The stepped leader is a dim 50 yard long "streak" of lightning starting from the cloud. The stepped leader will continue toward the ground in steps of 50 yards. Each stepped leader takes about 50 millionths of a second to start branching off into one or more additional stepped leaders. As the stepped leader(s) near the ground, the positively charged earth and objects on earth start to be attracted to the stepped leader, see figure 1. In a human, if you have your hair standing on end you are being attracted to the stepped leader of a lightning strike. Once the stepped leader reaches one of the positively charged streams from the ground the positive charges we get what we all now a lightning, a bright stream in the sky that has several branches (see figure 2). The positive charges going up to the cloud are actually where we see the bright lightning, this is also know as the return stroke. When the return stroke reaches the cloud, if there are still more negative charges left the lightning will continue with negative charges being taken to the ground and another return stroke taking positive charges to the cloud.



Diagrams adapted from "**All About Lightning**" by M. A. Uman, 1986.

So what causes thunder?

The return stroke has a temperature of about 100,000 degrees Fahrenheit (5 times the temperature of the sun). The air around the return stroke will rapidly warm. As the air warms it will also rapidly expand and compressing the air around itself. As the expansion continues the air produces a sound wave which we here as thunder.

What Causes a "Blue Moon?"

By Tom Salem, Science Operations Officer

The expression "once in a blue moon" means something is not common or it rarely happens. So how often do blue moons happen and what is a blue moon? Is the blue moon a moon that is the color blue, is it a special full moon, or is it a sad moon? The moon does not have feelings, so that eliminates the moon being sad. But what about the other two options?

The second full moon of a single month is commonly called the "blue moon;" so it is a special full moon. Two full moons in one month happen about every 3 years. The next blue moon after this year will occur in June, 2007. There were 2 full moons during the month of July in 2004. The first occurred on July 2 and the second on July 31. So, the full moon on July 31 was our "blue moon."

The moon on July 31 would've been white, just like most other full moons, but can there be a moon blue in color? The answer is yes, the last known blue moon was observed in Edinburgh, Scotland, in September 1950--truly a rare event. One of the observers was an astronomer, Robert Wilson of the Royal Observatory. Mr. Wilson took measurements and concluded the moon was blue because the moon light was going through a cloud of small particles from forest fires in Alberta, Canada, which had come across the Atlantic ocean (according to the book Clouds in a Glass of Beer by Craig Bohren, 1987).

The color of the moon is essentially white or a combination of all colors. The moon observed high in the sky is almost always white, because there path of the moon light through the atmosphere goes through the fewest amount of atmospheric particles. The more particles—air molecules, water vapor, and pollutants—light comes in contact with the more light is scattered away. Most atmospheric particles scatter blue light first, because the particles are smaller than the wavelength of the light (about 500 nanometers or 1/100,000 inch). So the moon on the horizon—where the light has gone through more atmospheric particles—has lost most of its blue color and thus appears many times an orange or red color.

Most atmospheric particles are smaller than the wavelength of visible light, so the blue light is scattered first. Particles with sizes greater than the wavelength of light (for example, cloud droplets) will scatter all the colors of light equally. Yet, particles about the same size have the wavelength of light will scatter red light first. Very few particles in the atmosphere are the same size as the wavelength of light. So to see a blue moon is rare indeed.

Do you have a meteorologically related question you would like to ask? If so, email Thomas.Salem@noaa.gov, and we will cover it in the next edition of "Under the Big Sky."